UNITED STATES DEPARTMENT OF AGRICULTURE
U.S. Food Distribution Administration

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FEATHERWEIGHT FOODS

Fastest growing industry in the United States is the one devoted to the dehydration of foods. In 1940 the Nation produced only 6 million pounds of dehydrated vegetables. This figure was more than doubled in 1941, was expanded 25 times again in 1942, and this year's production figure should be well over twice as large as last year's.

To a Nation faced with the necessity of shipping great quantities of foodstuffs overseas, dehydration has been an important answer to the lack of cargo ships.

Nearly all the dehydrated food produced in the United States in 1942 went for Government requirements. Army purchases during the year are estimated at 50 million pounds, and the Agricultural Marketing Administration (now absorbed by the Food Distribution Administration) bought 350 million pounds of dehydrated or concentrated products. Greatly increased quantities will be required for war needs in 1943. Army requirements for this year cannot be revealed, but it is estimated that Lend-Lease needs alone will approximate 930 million pounds.

It is impossible to exaggerate the importance of these "featherweight" foods in the Victory Effort. Thousands of tons of shipping and storage space are saved by sending concentrated foods to our soldiers and Allies abroad. Since most foods contain from 10 to 90 percent water, the removal of this water means that one ship carrying concentrated products can do the work of from 5 to 10 ships.

In addition to this saving of cargo and storage space, dehydration also makes it possible to send abroad many foods that otherwise could not stand up well under the long, hard haul -- such products as eggs, milk, and vegetables. Dehydration of these products also simplifies their preparation and, by reducing their perishability, enables them to be stored until they are needed.

Eggs, milk, fruits, vegetables, and even meat, lend themselves well to dehydration. The seven vegetables most commonly dehydrated for Government needs are white potatoes, onions, carrots, cabbage, beets, rutabagas, and sweet potatoes. Other concentrated food products recently included on the regular menus of our soldiers stationed abroad are citrus fruit concentrates, powdered soups, baked beans, tomato juice, cranberries, and apple nuggets, as well as dried milk and eggs.

The newly established Food Distribution Administration, which has charge of the war food job from the time agricultural commodities leave the farm until they reach the consumer, buys large quantities of dehydrated and concentrated foods for the United Nations.

Although the shipping situation in World War I was not as tight as at present, dehydration, particularly of vegetables, was expanded during the war period. During that time, 8,905,158 pounds of dehydrated vegetables, mostly potatoes, were shipped to the U. S. Army overseas. But because many commercial concerns went into the dehydration business poorly equipped and with little understanding of the problems, dehydrated food was not a great success in those days. There is as much difference between dehydrated foods today and those of 1918 as there is between today's flying fortresses and the old Jennies of the previous war.

THE DEPARTMENT'S EXPANSION PROGRAM

The immediate need for great expansion in the dehydration industry resulted in the Department of Agriculture's inauguration of an expansion program to aid canners and other food processors whose operations are curtailed because of tin conservation and other restrictions to enter dehydration. Canners and other processors already in the field are the logical ones to step into the new program because of their existing facilities and experience.

The Department's program not only provides assistance in obtaining priorities for materials needed for conversion and production, but also provides technical assistance. Blueprints of designs for dehydration plants of different capacities, and mimeographed technical information on the dehydration of the various products are being made generally available by the Department.

In 1942, the Department sponsored two schools for training processors in dehydration operation, one at Albany, California, and the other at Rochester, New York. They were attended by approximately 300 persons.

Today, some 750 plants are devoting part or all of their facilities to the production of dehydrated foods, including powdered milk, eggs, citrus concentrates, fruits, and vegetables. By the end of next year, it is hoped that almost as many more will be in production.

PURCHASE SPECIFICATIONS

As in the case of canned goods, dehydrated foods for the Army and for the United Nations, are purchased on the basis of Federal specifications. Unless otherwise stated in the specifications, inspection is at the point of processing. Currently, grading of fruits and vegetables for both the Army and the Food Distribution Administration is done by the Processed Fruit and Vegetable Division of the FDA. In addition to inspection of the finished product the Government inspectors check on such important matters as plant sanitation, processing, and packaging.

NUTRITIONAL VALUE

Research conducted by the Department's Agricultural Research Administration and other agencies indicates that freshly dehydrated foods contain almost the same amounts of proteins, carbohydrates, and minerals as fresh foods, and about the same as canned goods. Vitamins B-1 and G are stable upon dehydration and subsequent storage for 12 months, whereas Vitamin C is lost to the extent of 20 to 60 percent upon dehydration and 50 to 85 percent after a year's storage

Vitamin A (carotene) content of vegetables is reduced 10 to 30 percent and a decrease of an additional 10 to 30 percent has been noted after 12 months.

Present methods of dehydrating citrus fruit juices succeed in retaining most of the vitamin C. Dehydration neither increases nor decreases caloric value. The number of calories is greater in a pound of dehydrated food only because the food is concentrated.

FLAVOR

How about the flavor of the featherweight foods? Many luncheons and dinners made up of all-dehydrated foods have been served to scientists, high-ranking Army officers, Congressmen, and plain, everyday Americans. In every instance the diners were astounded, when they had finished their novel meal, to learn that they had eaten only dehydrated meats and vegetables. All voted the concentrated food equal to the fresh variety. They were unable to distinguish the dehydrated potatoes when they were cooked, from the fresh ones. And even those people not especially keen on spinach asked for a second helping of the dehydrated greens.

WATER CONTENT

Properly dehydrated vegetables generally contain less than 7 percent of water, and usually about 5, but sometimes as low as 3-1/2 percent. In general, it takes about 10 pounds of fresh vegetables to make 1 pound of dehydrated, about 11 pounds of liquid skim milk to make 1 pound of dried skim, about 3 dozen fresh eggs to make 1 pound of dried, and about 4 pounds of raw meat to make 1 pound of the dehydrated product.

DEHYDRATION METHODS

Dehydration, in its simplest terms, means the removal of most of the water from a fresh product. In the case of fruits and vegetables this is done by heated air. The product is cut into cubes, slices, or shreds and placed on trays or conveyor belts in a chamber where the heated air is driven over it to remove the moisture. Substantially the same result has been obtained for many years by simply drying fruits in the sun.

Modern dehydration is a method of speeding up the drying process by mechanical means. The time required to dehydrate a vegetable under present methods ranges from 7 to 15 hours with about an 8-hour average. White potatoes, for example, require up to 8 hours while onions and sweet potatoes take 14 to 15 hours. Milk and eggs, on the other hand, are sprayed through a nozzle into a chamber heated to over 300 degrees Fahrenheit and they dry at once, and fall as flakes.

A number of methods of dehydration currently are in use. The basic principle of all is that generally the food product should be dehydrated from the inside out: which means that great heat cannot be applied at the beginning of the drying process without the danger of causing a bony-like structure to form on the surface of the powdered or crystallized foods. It is necessary to keep the exterior moist by controlled humidity until the innermost part of the product has acquired the desired temperature. After this the heat can be increased. Thus the product gives off its own moisture and becomes dehydrated.

PRE-PROCESSING

Before any fruit or vegetable actually is dehydrated, it first must be "pre-processed", which includes selection, grinding, washing, and blanching. All vegetables except onions must be blanched before drying. Blanching or scalding is accomplished usually with steam and occasionally with water, depending on the product handled. To illustrate how important this blanching process is, it should be pointed out that dehydrated potatoes that are not blanched become an unsatisfactory product after they have been stored for several months. Blanching acts as a sterilizer by killing certain bacteria which otherwise would grow and impair food value. In general, unblanched products are poor in keeping quality and lose their vitamin content faster than blanched products.

VEGETABLES

Vegetable dehydration is being built into a significant industry. In 1941, there were only 20 vegetable dehydrating plants with a total annual capacity of about 15 million pounds of dehydrated products. Largely through the Government's expansion program, production has been increased greatly and should reach about 75 million pounds this current (1942-43) fiscal year. Requirements for the next year, however, call for more than 5 times as much dehydrated vegetables, so much more expansion is needed. All dehydrated vegetables are needed for direct war needs.

Most important of the dehydrated vegetables are potatoes. More dehydrated white potatoes -- nearly 6 million pounds -- have been bought for shipment to the United Nations than any other dried product. Under present plans, the Food Distribution Administration will send abroad almost 65 million pounds in 1943. A major portion will be processed in Maine and Idaho, and a large quantity will be Julienne style since this style lends itself readily to the various methods of preparation, especially French fries, home fries, boiled and mashed. At present, several large processing plants are in operation in Idaho and it is hoped that by the first of March from 6 to 8 plants will be in production in Maine. A typical plant will be able to cut up about 2 carloads of raw potatoes a day or make from 300 to 500 pounds of the finished product per hour.

CITRUS CONCENTRATES

The processing of citrus fruits into special concentrates is now an important industry with some 20 plants (17 in California and 3 in Florida) now in operation. Under the process, the juice of 7 gallons of fresh orange juice can be reduced to 1 gallon of concentrate. In the case of lemons and grapefruit the ratio is 5 to 1 and 6 to 1 respectively. More than 2,200,000 gallons (26 million pounds) of citrus concentrates had been purchased for the United Nations up to January 1, 1943. Of this amount about 90 percent was concentrated orange juice and 10 percent, concentrated lemon juice. In December 1942 the Food Distribution Administration made its first purchase of grapefruit concentrate -- 5,500 gallons.

All three citrus concentrates are processed in the same way. In making the orange concentrate, for example, juice from fresh oranges is evaporated under pressure. Whereas the fresh product contains from 10 to 15 percent of total solids, the concentrate contains 65 to 70 percent. The vitamin C content is reduced only slightly. Ordinarily the juice is flash-pasteurized before concentration, but nothing is added, neither sugar nor preservatives.

Pharmaceutical houses in Great Britain pack the juice in 6-ounce bottles, after it has been blended and standardized. It is distributed only to children and each British family is rationed on the basis of the number of children. The concentrate is diluted with water (reconstituted) at home.

SOUP

Up to January 1, 1943, more than 7 million pounds of dehydrated soup were bought by the Food Distribution Administration for Lend-Lease, the Red Cross, and FDA's School Lunch program, and well over half a million pounds of dehydrated tomato flakes, which were used as the basis for concentrated soups. Much of the dehydrated tomato flakes is manufactured by spraying cooked tomato pulp on hot revolving drums where the water quickly evaporates. The dried product then peels off the drums like paper, is crumbled into flakes, and these become soup when water and seasoning are added.

From 4 to 10 percent of the food material in the dehydrated soups manufactured both for export and domestic use, consists of dehydrated vegetables used for seasoning. These vegetables are onions, cabbage, carrots, parsley, and celery. The dehydrated vegetable industry, prior to the war, was producing commodities primarily for this use.

EGGS

Outstanding in the dehydrated food field is the egg-drying industry. As recently as 1941 there were only 16 plants, with a normal operating production of only 10 million pounds. Today there are nearly 130 egg-drying plants operating or proposed with an annual capacity approaching 400 million pounds. Lend-Lease purchases from March 1941 to the end of 1942 totaled close to 250 million pounds of the whole dried product.

Whole dried eggs are packaged in 150 to 200 pound barrels and 14-pound cartons for commercial use and in small moisture-proof packages for individual consumers. Thirty dozen eggs (one case) before dehydration weigh about 45 pounds and occupy 2-1/2 cubic feet of space, including the case, while the same eggs when dehydrated weigh only 11 pounds and occupy less than half a cubic foot. The 5-ounce consumer-sized package represents a dozen shell eggs.

Two general methods of drying eggs are used -- the spray and the tray. In the spray method generally used for whole dried eggs, the eggs are sprayed under pressure into a high-ceiling chamber heated to a temperature of from 160 to 170 degrees Fahrenheit. The other method, used largely for drying whites of eggs, involves drying in metal trays in especially constructed cabinets through which hot air is forced. Before drying by either method the eggs are broken, strained, and churned.

Dried eggs are used in cakes, doughnuts, pancake flour, and noodles. They also can be used as scrambled eggs for the table and in almost every other form except as fried eggs. Some 13 plants in the United States are packaging these eggs.

DRIED MILK

Although the first Lend-Lease requirements emphasized evaporated milk, the lightening shipping situation changed the picture. Evaporated milk had to give way to the more concentrated product -- powder.

Although evaporated milk requirements of the United Nations have dropped, direct war requirements for dried skim milk -- roller and spray -- have risen to 240 to 300 million pounds annually -- an amount, in the case of spray, equal to over 90 percent of the production. War requirements for whole milk powder are almost unlimited.

Roller and spray milk are named in accordance with the way they are manufactured. In the roller process, fluid skim milk is poured upon a hot roller and comes out in a thin layer whereupon a device scrapes off the dry flakes. Spray milk is made in the same way as dried eggs; the fluid skim milk is sprayed under pressure into a heated chamber.

For direct war uses about 2 pounds of spray processed milk are needed for every pound of roller processed milk, or around 200 million pounds a year. The British, the Russians, and the other United Nations prefer spray powder because it can be reconstituted (restored to its original water content) more easily and is therefore preferable for drinking purposes. Roller milk can be used in all forms of cooking where quick and complete reconstitution is not the main factor under consideration. About 43 percent of the total 1942 skim milk powder production was purchased for export to Allied Nations.

DEHYDRATED MEATS

Thus far (up to January 1, 1943) the Army has bought no dehydrated meats. However, in October 1942, the Food Distribution Administration awarded its first contract for dehydrated pork for shipment overseas to the United Nations. The contract, with a Mid-west meat packer, was for approximately 110,000 pounds.

This new product, which never has been on the commercial market, is made of pre-cooked, fresh, extremely lean pork. Granular in shape, its color and texture are similar to brown sugar. Dehydrated pork has about one-third the volume of the original boneless meat and weighs about one-fourth as much.

Although in the experimental stage when the war began, meat dehydration has made rapid strides in recent months. Large-scale production has been encouraged by Government orders and it is expected that by early in 1943 at least 10 processors, mainly in the Mid-West, will be producing the concentrated pork.

Dehydrated pork now is being sent abroad in preference to beef, as the supply of the former generally is more available. FDA awarded the first contract for dehydrated beef last July. The amount was 80,000 pounds.

Experimental work on the dehydration of meat, by the Department's Agricultural Research Administration, began in February 1942. At the outset work offered a more puzzling problem than beef, because its fat is subject to quicker spoilage. However, this problem now has been solved by utilizing only the leanest cuts.

Several different types of machines and processes are being studied by the Department of Agriculture and other agencies in order to meet varied conditions in the new industry.

Modern processes of dehydration scientifically remove water from fresh meat at low cooking and drying temperatures and the resulting product retains a maximum of essential food elements, such as minerals and vitamins. As far as is known, the body-building proteins are not affected by the process any more than they would be in normal cooking procedures. Mineral elements are retained in the product.

In preparing dehydrated meat for consumption, the product may be reconstituted first by soaking for a time in water. It then is boiled vigorously for 10 minutes and simmered for 20 minutes more. Subsequent cooking depends on the type of dish desired. Meat ground in relatively small pieces can be made into stews and meat pie; the more finely ground product is suitable for meat loaf, meat cakes, hash, and soup. Many of the dishes made of dehydrated meat cannot be distinguished from those made of fresh meat.

LOCATION OF DEHYDRATION PLANTS

To date the largest concentration of vegetable dehydration plants has been in California (where the industry began prior to the war). But the plants now extend into Idaho, Colorado, Washington, Oregon, and Michigan, as well as into certain Eastern and Southern States, especially New York, New Jersey, Pennsylvania, Maryland, Maine, North Carolina, Texas. Other States are expected to enter the picture soon, as fast as processing facilities are available for conversion purposes.

Orange juice concentrate is prepared mostly in Florida and in California.

Greatest concentration of egg-drying plants is in the Mid-West, on a line running north from the east-center of Texas up through the Grain Belt. There are also a number of plants along the Mississippi Valley from Louisiana northward. Plants also are operating in the poultry regions of Washington and Oregon on the West Coast, and as far east as Pennsylvania and New York.

Dried-milk production, naturally enough, centers in the major dairy areas of Minnesota and Wisconsin, Michigan, and other Great Lake States, and in the great eastern milk--shed, New York, Pennsylvania, and Vermont, and in California, Washington, Oregon, and Utah in the Far West.

COST OF DEHYDRATION PLANTS

The average cost of a dehydrating fruit and vegetable unit has been variously estimated at from $15,000 to $20,000 for one unit that will produce 1,000 pounds of food a day. This is only a rough approach, however, because vegetables dry at various rations: cabbages at 18 to 1, for instance, and potatoes at about 4 to 1.

Included in the existing facilities for dehydrating plants (as of December 20, 1942) are: 457 plants for the production of milk; 95 for vegetables and fruits; 3 for meat; 20 for citrus concentrates and pectin; 90 for eggs; [illegible] 20 for soups.

On an overall basis the number of plants needed to meet the 1943 requirements for dehydrated foods are as follows, according to the latest Department of Agriculture estimate: vegetables, 250; fruits, 20; soups, not determined yet, survey in process; milk, 35 (on basis of maintaining domestic production at the rate of 128 million pounds a year); eggs, 26; and meat, 10.

Under present plans the expansion of plant facilities for 1943 will be limited to companies that have had considerable experience in dehydration, or to canners who already are equipped with a substantial part of the machinery required for large-scale drying of food. In this way the overseas requirements of our armed forces and allies can be met with the least possible demand for new machinery and also the least possible withdrawal from other war industries of strategic metals and materials.

Estimates of Dehydrated Foods Required for Allied Shipment in 1943-44, and Quantities Bought March 1941--January 1943

ITEM	1943-44 REQUIREMENTS *	AMOUNT ALREADY BOUGHT ** MARCH 1941 TO JANUARY 1, 1943
	Pounds	Pounds
Dried whole milk	35 to 40 million	8,997,200
Skim milk	240 to 250 million	286,582,447
Dried eggs	335,000,000	246,983,037
White potatoes	64,700,000	5,872,120
Cabbage	22,000,000	343,600
Onions		956,200
Carrots	5,300,000	491,800
Beets	18,350,000	14,400
Rutabagas	4,650,000	250,000
Tomato products	18,500,000	670,000
Baked beans	6,650,000	None
Meats		
Pork	60 to 80 million	1,264,720
Beef	None	80,000

* U. S. Military requirements not included

** FDA purchases only

Weights of Dehydrated Food Compared with Fresh, Raw Product

Product	Weight of Raw Product	Equivalent Weight of Dehydrated Product
Whole milk	8 lbs. fluid	1 lb. powder
Skim milk	10 lbs. fluid	1 lb. powder
Eggs	58 lbs. shell (3 doz. shell)	11 lbs. powder (1 lb. powder)
Pork	4 lbs. boneless	1 lb. dehydrated

VOLUME AND WEIGHT RELATIONSHIP BETWEEN
FRESH AND DEHYDRATED VEGETABLES

Vegetable	Weight of 5 bu. raw product	Volume of space occupied	Yield of dehydrated product from raw	Dehydrated and packed in 5-gallon can or equivalent		Approximate saving in shipping space	
				Weight	Volume		
	Pounds	Cu. Feet	Percent	Pounds 1/ (approx.)	Cu. Feet	Percent	Percent
Topped beets	260	6.222	10	29 (1 can)	1.412	77	88
Cabbage	167	6.222	8	15 (1 can)	0.706	88	91
Carrots	250	6.222	10	28 (2 cans)	1.412	77	88
Onions	285	6.222	10	32 (2 cans)	1.412	77	89
Potatoes	300	6.222	19	62 (4 cans)	2,823	55	81
Rutabagas	280	6.222	8	25 (2 cans)	1,412	77	91
Sweet Potatoes	275	6.222	26	79 (5 cans)	3,530	43	72

1/ Includes weight of container whereas first two columns do not.

Note: All figures are approximate and represent an average; variety differences should be taken into consideration in determining: yield, weight and volume of the dehydrated product.

Egg Drying and Packaging Firms in the Northeast:

John T. Christian Company, Pittsburgh, Pa.
Doughnut Corp. of America, Frankfort, N.Y. and New Berline, N.Y.
Samuel Dunkel & Company, New York City and Walton, N.Y.
Marshall-Kirby & Company, Jersey City, N.J.
Kirby Egg Products, Jersey City, N.J.
Stern, Jacob (Daley-Allen Plant), North Bergen, N. J.
Super-Spray Products Company, Philadelphia, Pa.

5 oz. Packages

Samuel Dunkel & Company, Newark, N.J.(contract expired Jan. 15)
Atlas Packaging Company, Lehigh-Starrett Bldg., New York City
William S. Scull Co., Camden, N.J.
R. C. McAteer Company, Butler, Pa.
General Mills, Buffalo, New York

14 lb. Packages

Paul R. Dillon, Hudson Street, N.Y.C.
Chas. E. Griffin, 115 Broad St., New York City

Companies Producing Various Dehydrated Foods in the Northeast:

Durkee Famous Foods, Elmhurst, L. I.
Arrow Dehydrating Co., West 66th St., New York City
Sweet Life Foods, Marlboro, N.J.
Natural Sugars, Inc., West 26th St.,New York City
American Processing Corp., Mount Vernon, New York
Doyle Packing Co., Inc., Long Branch, N.J.
Campbell Soup Company, Camden, N.J.
Wood and Selick, Inc., New York City
Far Eastern Mfg. Co., Brooklyn, New York
P. J. Ritter Co., Bridgeton, New Jersey
Hills Brothers, Washington St., New York City
Jersey Belle Food Products, New York City
American Dehydrating Company, Long Island City
Martha E. Bussler Co., New York City
Clifton Dehydrating Company, Clifton, New Jersey
Atlas Canning Company, Glendale, L. I.